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A new species of *Leiurus* Ehrenberg (Scorpiones: Buthidae) from Sinai, Egypt and comments on its relationships with *L. quinquestriatus* and *L. hebraeus* using morphological and molecular evidence

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Sinai;
Egypt.

Abstract. – The genus *Leiurus* was first described by Ehrenberg in 1828 as *Androctonus* (*Leiurus*) *quinquestriatus*. For almost two centuries, it was considered monotypic, with only two valid subspecies: *Leiurus quinquestriatus quinquestriatus* (Ehrenberg, 1828) and *Leiurus quinquestriatus hebraeus* (Birula, 1908). However, over the last 20 years, several new species of *Leiurus* have been described in Africa and the Middle East. Despite this, some populations, such as those in the Sinai Peninsula in Egypt, remained poorly defined. Previous studies suggested that the Sinai population is distinct from both *L. quinquestriatus* and *L. hebraeus* (Birula, 1908). In this study, we conducted a more comprehensive comparison of the Sinai population and *L. quinquestriatus* and *L. hebraeus* using morphological and molecular evidence. Our results suggest that the Sinai population indeed represents a distinct species, which we describe based on this evidence.

Badry A., Saleh M., Sarhan M. M. H., Younes M., Lourenço W. R. & Ythier E., 2023. – A new species of *Leiurus* Ehrenberg (Scorpiones: Buthidae) from Sinai, Egypt and comments on its relationships with *L. quinquestriatus* and *L. hebraeus* using morphological and molecular evidence. *Faunitaxys*, 11(54): 1 – 10.

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Introduction

As already outlined in several previous publications (*e. g.* Lourenço et al., 2002, 2006), it is likely that the number of new species of the genus *Leiurus* would rapidly increase as more and more specimens from distinct populations become available. This was confirmed for the populations of Middle East (Lowe et al., 2014; Lourenço, 2022), but equally for the African populations (*e. g.* Lourenço, 2019, 2020a,b; Lourenço & El-Hennawy, 2021; Lourenço et al., 2018). The progressive improvement in our knowledge of the diversity within the genus was partially driven by an increased collecting effort, but in most cases due to recent examination of old specimens available in collections in Museums such as the MNHN in Paris, which were not previously studied. In many, if not most cases, these more or less 'old' specimens were collected in regions which are no longer attainable in present days, mainly due to security reasons (Lourenço, 2020a,b, 2021). Although all the efforts invested in the last twenty years, a few populations remain poorly defined, such as the one distributed in the Sinai Peninsula in Egypt. Previous studies, based on both morphological and molecular approaches (Lowe et al., 2014; Sarhan et al., 2020) strongly suggested that the Sinai population could be distinct from the populations of both *Leiurus quinquestriatus* Hemprich & Ehrenberg, 1829 and *Leiurus hebraeus* (Birula, 1908). In the present study, we carry out a more detailed morphological examination of a larger sample of the *Leiurus* population of the Sinai Peninsula. We also undertake comparative molecular analysis of that population and samples representing *L. quinquestriatus* and *L. hebraeus*.

Reviewer: Gérard Dupré (*France*).

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Material and Methods

Illustrations and measurements were obtained using a Wild M5 stereomicroscope with a drawing tube and ocular micrometre. Photographs were made with a Canon EOS 7D and Adobe Photoshop software. Measurements follow Stahnke (1970) and are given in mm. Trichobothrial notations follow Vachon (1974) and morphological terminology mostly follows Vachon (1952) and Hjelle (1990).

Molecular analysis

In the present study, the DNA was extracted from three samples of *Leiurus hebraeus* from Jordan were extracted from freshly preserved specimens (96% ethanol) using Qiagen extraction kit (Qiagen) according to its manufacturer's instructions. A fragment of 16S rRNA gene was amplified via standard polymerase chain reaction (PCR) using invertebrate universal primers as determined by Gantenbein et al., (1999). The sequences were edited using BioEdit v. 7.2.5 Hall (1999). The new sequences generated from all three samples, were added to the sequences previously generated from four samples of *L. sinai* **sp. n.**, *L. arabicus* and *L. haenggii* from Saudi Arabia by (Sarhan et al. 2020; Alqahtani and Badry 2020). Also, additional sequences of species of *Leiurus* from Egypt, Oman, and Turkey, were retrieved from GenBank. The sequence of *Androctonus crassicauda* (Olivier, 1807; AY156570.1) was downloaded as the outgroup. The sequences were aligned using the default settings of ClustalW in Mega 11 (Tamura et al. 2021), and nucleotide composition was calculated from the ingroup sequences only. Genetic distances (p-distances) for the entire data set were calculated using Mega 11 (Tamura et al. 2021). Phylogenetic analyses of the 16S data set ($n = 23$) were performed following Alqahtani and Badry (2020b). Maximum-parsimony and neighbor-joining analyses were conducted with Paup v. 4 (Swofford 2000) using heuristic clustering based on TBR branch swapping. A character was considered missing when a gap was present in an alignment. To assess the degree of confidence within the nodes, 1000 bootstrapping replicates and random additions of taxa were used (Felsenstein 2002). The best-fit nucleotide evolution models were preferred using MrModeltest v. 2.3 (Nylander 2004) based on the Akaike Information Criterion (Akaike 1973) in Paup v. 4 (Swofford 2000). To infer the geographic structure, Bayesian inference was implemented using MrBayes v. 3.1.2 (Ronquist et al. 2012) for a million generations, and output parameters were plotted with Tracer v. 1.7 (Rambaut et al. 2018).

Taxonomic treatment

Family **Buthidae** C.L. Koch, 1837

Genus ***Leiurus*** Ehrenberg, 1828

***Leiurus sinai* sp. n.** Badry, Saleh, Lourenço & Ythier
(Fig. 1-4, 7-15, Tab. I)

ZooBank: http://zoobank.org/CE18F3E1-372B-4657-8F33-1464A5CFC2FF

Holotype, ♀, Egypt, N Sinai, Gebel Al Maghara (ABLQ30105), 10/V/1995 (M. Saleh).

Paratypes

- 1 ♀, idem holotype (ABLQ40109);
- 15 ♂ & 16 ♀, Sinai, Taba (ABLQ4001-ABLQ40031), 15/VIII/2016 (A. Badry);
- 1 ♂, 1 ♀ & 2 ♂ juveniles, Sinai, Bir El Hassana (coll. E. Simon, 1319), no date, no collector (RS-1578).

The holotype and paratypes material is deposited in the Muséum national d'Histoire naturelle, Paris and at the Al-Azhar University Zoological Collection (AUZC), Nasr City, Cairo, Egypt.

Comparative material used in the present study

Leiurus quinquestriatus

- Egypt, Al-Kharga, V/2006 (Ph. Geniez), 1 ♀;
- Dakhla Oasis, 23/IX/2014 (A. Badry), 1 ♂;
- Fayium Depression, 20/II/2015 (A. Badry), 1 ♀.

Leiurus hebraeus

- Jordan, Dab'A, 7/IX/2013 (M. Al-Saraireh & B. A. Afifeh), 1 ♀;
- Petra, 15/X/2020 (M. Al-Saraireh & B. A. Afifeh), 1 ♂ & 1 ♀;
- Un Al Dananiv, 7/IV/2021 (M. Al-Saraireh & B. A. Afifeh), 2 ♀;
- Kafraim Dam, 4/V/2020 (M. Al-Saraireh & B. A. Afifeh), 1 ♀;
- Kurkumah, 10/I/1993 (RSCN), 1 ♂ & 1 ♀.

The totality of the material is now deposited in the Muséum national d'Histoire naturelle, Paris.

Etymology. – The specific name is placed in apposition to the generic name and refers to Sinai Peninsula, where the new species was found.

Diagnosis. – The female holotype has a total length of 76.7 mm, while one male paratype from Bir El Hassana has a total length of 69.4 mm; the other adult paratypes show more or less similar values. The overall size of the Sinai species seems to be closer to that of *L. hebraeus*, since most adults of *L. quinquestriatus* show larger sizes. The ground colour is yellow to slightly brownish-yellow; body darker than appendages; ventral carinae of metasomal segments slightly spotted; segment V more heavily spotted with blackish, but some variation can be observed among specimens; carapace only moderately spotted mainly in its central zone. Ocular tubercle moderately prominent; postmedian furrow moderately deep. Pectines with 34 to 40 teeth in males and 30 to 36 teeth in females. Median carinae on sternite III moderate; on sternite IV vestigial; sternite VII with mediate intercarinal surface almost without granulations, shagreened. Pedipalp fingers with 12-12 rows of granules; only in two specimens 11-12 was observed. Telson with a long aculeus, with a similar length to that of vesicle; weakly curved. Dorsal trichobothrium of femur **d_4** in a distal position in relation to external trichobothrium **e_1**; chela fixed finger trichobothrium **db** in the same level of **est**. For the other trichobothria the general pattern observed for the new species is similar to that of other *Leiurus* species, mainly to those of *L. hebraeus* and *L. quinquestriatus*.

Description (based on holotype and paratypes; morphometric values presented after the description in Table I)

Coloration. – Ground colour yellow to slightly brownish-yellow; pedipalps and legs yellowish to pale yellow. Carapace brownish-yellow with some spots in its central zone; eyes blackish. Mesosoma brownish-yellow with some infuscations on tergites I to VI; tergite VII paler. Metasomal segments I and II reddish-yellow; III and IV yellow with some vestigial blackish spots over ventral carinae; segment V spotted with blackish, but weakly marked on some specimens. Vesicle pale yellow with the aculeus yellow at the base and red at its extremity. Venter slightly reddish-yellow. Chelicerae pale yellow without any reticulated spots; teeth reddish. Pedipalps pale yellow overall except for the rows of granules on chela fingers which are slightly reddish. Legs yellowish with carinae reddish.

Morphology. – Prosoma: the anterior margin of carapace shows a weak concavity. Carapace carinae moderately to strongly developed; central median carinae moderate; anterior median carinae moderate to strong; central lateral strong; posterior median and posterior lateral carinae moderate to strong, terminating distally in a very small spinoid process that extends slightly beyond the posterior margin of the carapace. Intercarinal spaces with some irregular granules, and most of the surface is partially smooth, in particular laterally and posteriorly. Median ocular tubercle very slightly anterior to the centre of the carapace and moderately prominent; median eyes large in size and separated by about one and half ocular diameters; three pairs of lateral eyes well observed; presence of a fourth pair of reduced eyes. Mesosomal tergites I and II pentacarinate; III and VI tricarinate. All carinae moderate to strong, terminating

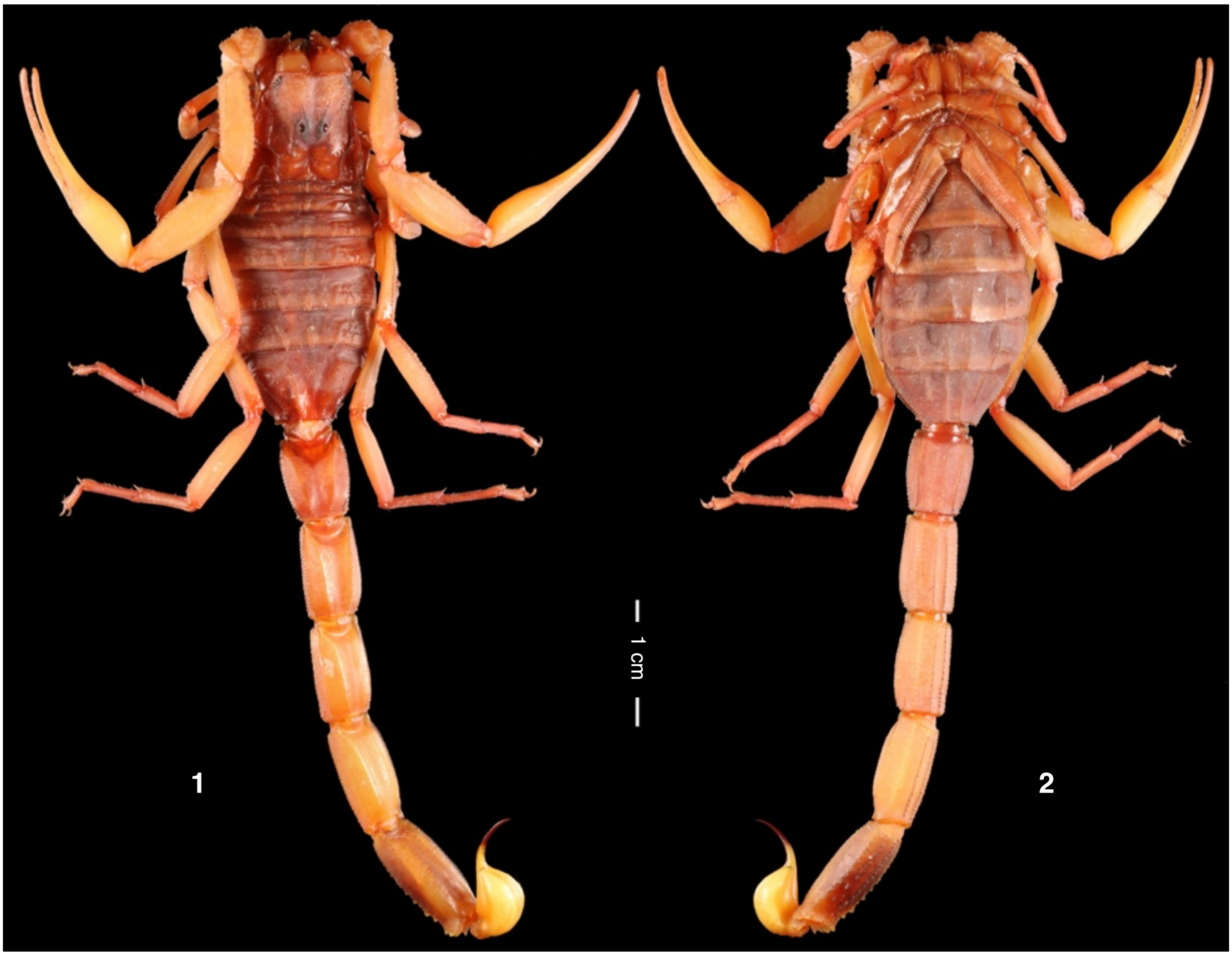

Fig. **1**-**2**. *Leiurus sinai* **sp**. **n**., ♀ holotype, habitus.
1. Dorsal aspect. **2**. Ventral aspect.

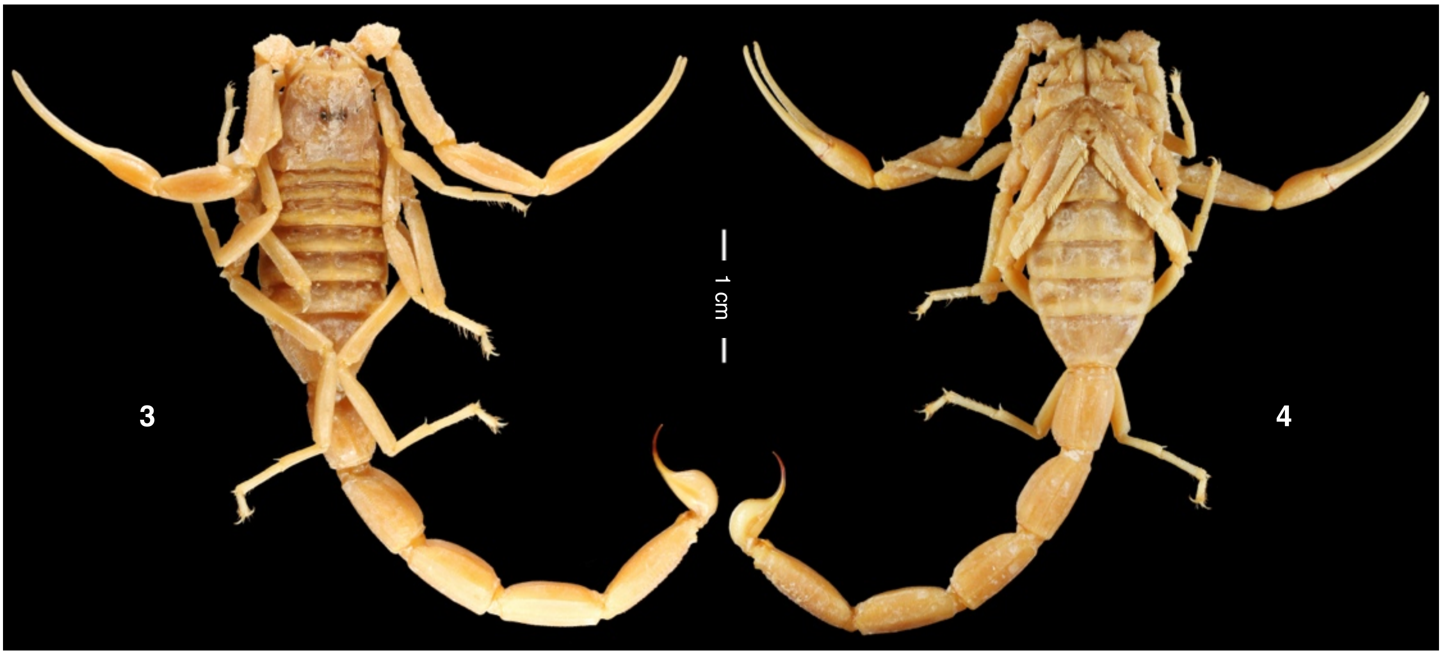

Fig. **3**-**4**. *Leiurus sinai* **sp**. **n**., ♂ paratype from Bir El Hassana, habitus.
3. Dorsal aspect. **4**. Ventral aspect.

distally in a spinoid process that extends slightly beyond the posterior margin of the tergite. Median carinae moderate on I, moderate to strong on II-VI. Tergite VII pentacarinate, with lateral pairs of carinae moderate to strong and fused; median carinae present on the proximal half, moderate to strong. Intercarinal spaces moderately granular. Lateral carinae moderate on sternite III; weak to vestigial on sternites IV to VI; moderate on VII; median carinae on sternites III and IV moderate to weak. Pectines long; pectinal tooth count 32-32 for female holotype and 40-38 for one male paratype from Bir El Hassana (see diagnosis for variation); Metasomal segments I to III with ten carinae, crenulate; lateral inframedian carinae complete on I; represented in its posterior zone by 1/3 of the length on II; by a few granules on III; IV with eight carinae. Dorsal and dorsolateral carinae moderate, without any enlarged denticles distally. All other carinae moderate to weak on segments I to IV. Segment V with five carinae; ventromedian carinae with several spinoid to lobate granules distally; anal arch with three slightly spinoid lobes. Dorsal furrows of all segments weakly developed and smooth; intercarinal spaces almost smooth, with only a few granules on the ventral surface of segment V. Telson smooth; subaculear tubercle absent; aculeus with a similar length to that of vesicle; weakly curved. Chelicerae with two denticles at the base of the movable finger (Vachon, 1963). Pedipalps: femur pentacarinate; all carinae moderately to strongly crenulate. Patella with seven carinae; all carinae moderately to weakly crenulate; dorsointernal carinae with 4-5 small spinoid granules. Chelae slender, with elongated fingers, smooth and without carinae. Dentate margins of fixed and movable fingers composed of 12-12 almost linear rows of granules in a large majority of the examined specimens. Legs: ventral aspect of tarsi with short spiniform setae more or less arranged in two rows. Tibial spurs present on legs III and IV and strongly marked. Pedal spurs present on all legs, moderately marked. Trichobothriotaxy: trichobothrial pattern orthobothriotaxic, type A (Vachon, 1974); dorsal trichobothria of femur in β (beta) configuration (Vachon, 1975). Dorsal trichobothrium of femur $\mathbf{d_4}$ slightly distal in relation to the external trichobothrium $\mathbf{e_1}$; chela fixed finger trichobothrium **db** in the same level of **est**.

Relationships. – The new species can be distinguished from *L. quinquestriatus* and *L. hebraeus*, the two most closely related species, by a combination of several characters:

(**i**) a smaller overall size,

(**ii**) dorsal trichobothrium $\mathbf{d_4}$ of the femur in a distal position in relation to external trichobothrium $\mathbf{e_1}$; chela fixed finger trichobothria **db** and **est** situated on the same level,

(**iii**) intercarinal surfaces of carapace with few granules, almost smooth; postmedian furrow moderately deep,

(**iv**) median carinae on sternite III moderate; median intercarinal surface weakly granular,

(**v**) pedipalp fingers with 12-12 rows of granules.

Molecular phylogenetic analyses

The phylogenetic analyses produced an identical topology between the maximum-parsimony and neighbor-joining trees, as shown in Figure 19. However, the maximum-parsimony tree's general topology differed slightly from those obtained through BI analyses. The first clade consists of all Arabian and Middle Eastern forms, which is further divided into two subclades. The first subclade includes *L. abdullahbayrami* from Turkey and those from the Arabian region (Saudi Arabia and Oman), while the second subclade includes *L. arabicus* from Riyadh as a basal clade to the sequences *L. haenggii* from southwestern Saudi Arabia, and *L. macroctenus* from Oman, which grouped together as a sister group. The second clade comprises all Egyptian forms and *L. hebraeus* from Jordan and is split into two subclades. The first subclade

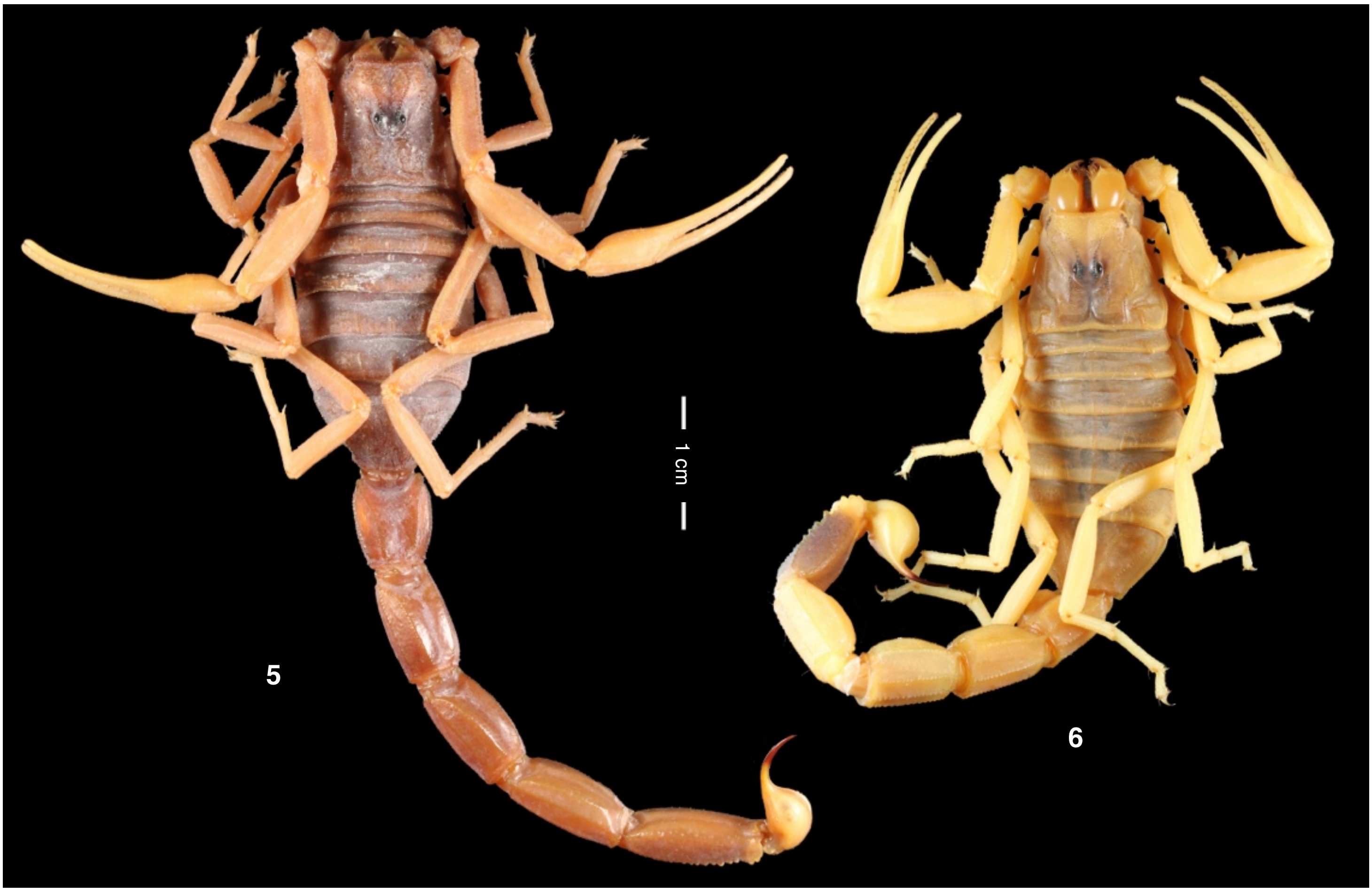

Fig. 5-6. Comparative material.

5. *Leiurus quinquestriatus*, ♀ from Al-Kharga, Egypt, dorsal aspect. **6**. *Leiurus hebraeus*, ♀ from Petra, Jordan, dorsal aspect.

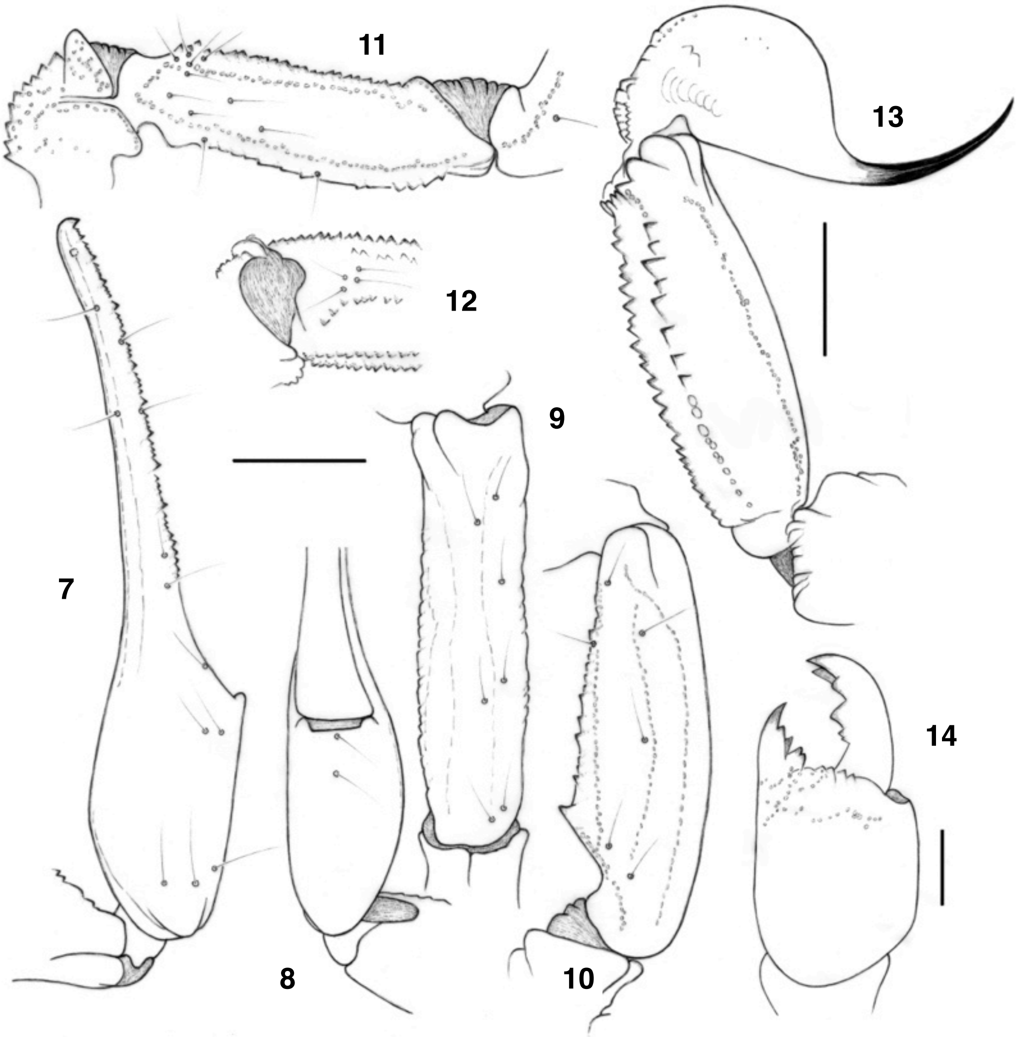

Fig. 7-14. *Leiurus sinai* **sp. n.**, ♀ holotype. **7-12**. Trichobothrial pattern. **7-8**. Chela, dorso-external (7) and ventral (8) aspects. **9-10**. Patella, external (9) and dorsal (10) aspects. **11-12**. Femur, dorsal (11) and internal (12) aspects. **13**. Metasomal segment V, lateral aspect. **14**. Chelicera, dorsal aspect. Scale bars = 3 mm except chelicera (1 mm).

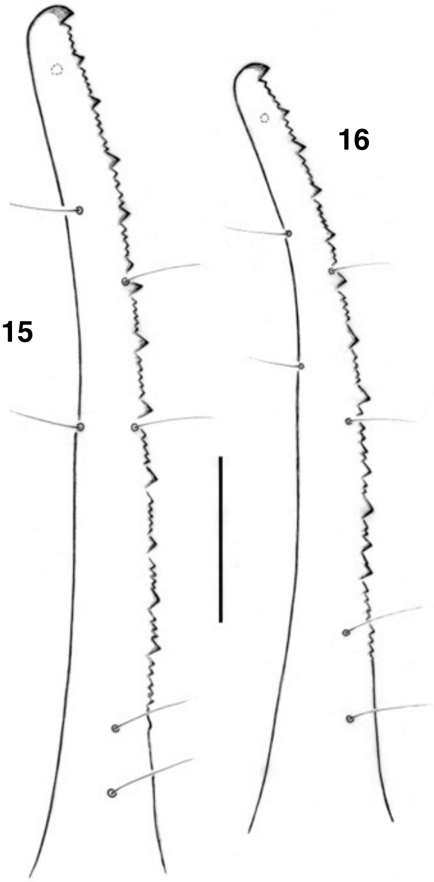

Fig. 15-16. Fixed fingers of *Leiurus sinai* **sp. n.**, ♂ paratype from Bir El Hassana and *Leiurus quinquestriatus*, ♂ from Dakhla Oasis, Egypt, showing the relative positions of trichobothria **db** and **est**; at the same level in *L. Sinai* **sp. n.**, while in *L. quinquestriatus* **est** is proximal in relation to **db**. Scale bar = 2 mm.

includes two samples of *L. sinai* **sp. n.** from Sinai and the others representing *L. hebraeus* of Jordan, while the second subclade includes all African Egyptian forms.

The two *L. sinai* **sp. n.** samples from Sinai and *L. hebraeus* from Jordan formed a monophyletic clade distinct from *Leiurus* populations from the African part of Egypt, Saudi Arabia, Turkey and Oman (Fig. 19). *L. sinai* **sp. n.** differed from *L. hebraeus* by a raw genetic distance of 3.0%, and from the other *Leiurus* species from Egypt and the middle east range from 9.0-18.0% (Table 3). The low genetic distance between *L. sinai* **sp. n.** and *L. hebraeus* may be due to their relatively recent divergence. In a recent study Lowe et al., (2014), found that four adult and subadult males from southern Sinai had slender pedipalp segments and reduced granulation between their posterior median carinae. They also referred to the southern populations of Sinai that might represent a yet undescribed species. In addition, the southern populations of *L. hebraeus* also exhibited more slender appendages, according to Levy et al., (1980). These authors suggested that a physical barrier prevented gene flow between these populations because *Leiurus* was excluded from the sandy coastal plain connecting North Africa and Sinai Peninsula. Sarhan et al., (2020) referred to the existence of a distinct population in Sinai based on molecular studies. The genetic isolation of *L. sinai* **sp. n.** is evident in the divergent evolution of polypeptide toxins and physicochemical profiles of their venom proteins (Smertenko et al., 2001; Nascimento et al., 2006).

Ecological comments

Most collections came from moderately vegetated wadis in northern and central Sinai's arid to hyperarid deserts. The species is probably lapidicolous, lives under rocks in wadis of both sedimentary and igneous hills and mountains. The Sinai Peninsula has a complex of high, rugged igneous, sedimentary and metamorphic mountains and hills. The mountainous and hilly country is dissected by a network of wadis draining into the Gulf of Aqaba or the plains of Sahel El Qaa and hence the Gulf of Suez. In northern Sinai a distinct group of hills namely, Gabal El-Maghara, Gabal El-Halal and Gabal Yelleq are located a relatively short distance south of the Mediterranean coast (Abu Al-Izz, 1971). These hills receive higher precipitation than the surrounding desert and are home to a wide range of relict fauna and flora. South of this region lies the Sinai Inland Desert and central plateau. The region includes the rugged sedimentary El Tih and Al-Ugma Plateaus, which are found along the northern flanks of the massive igneous core. In the lower regions to the north and south of the central Sinai plateau, there are numerous wadis that drain the area and often support a rich and diverse flora (Saleh, 1993).

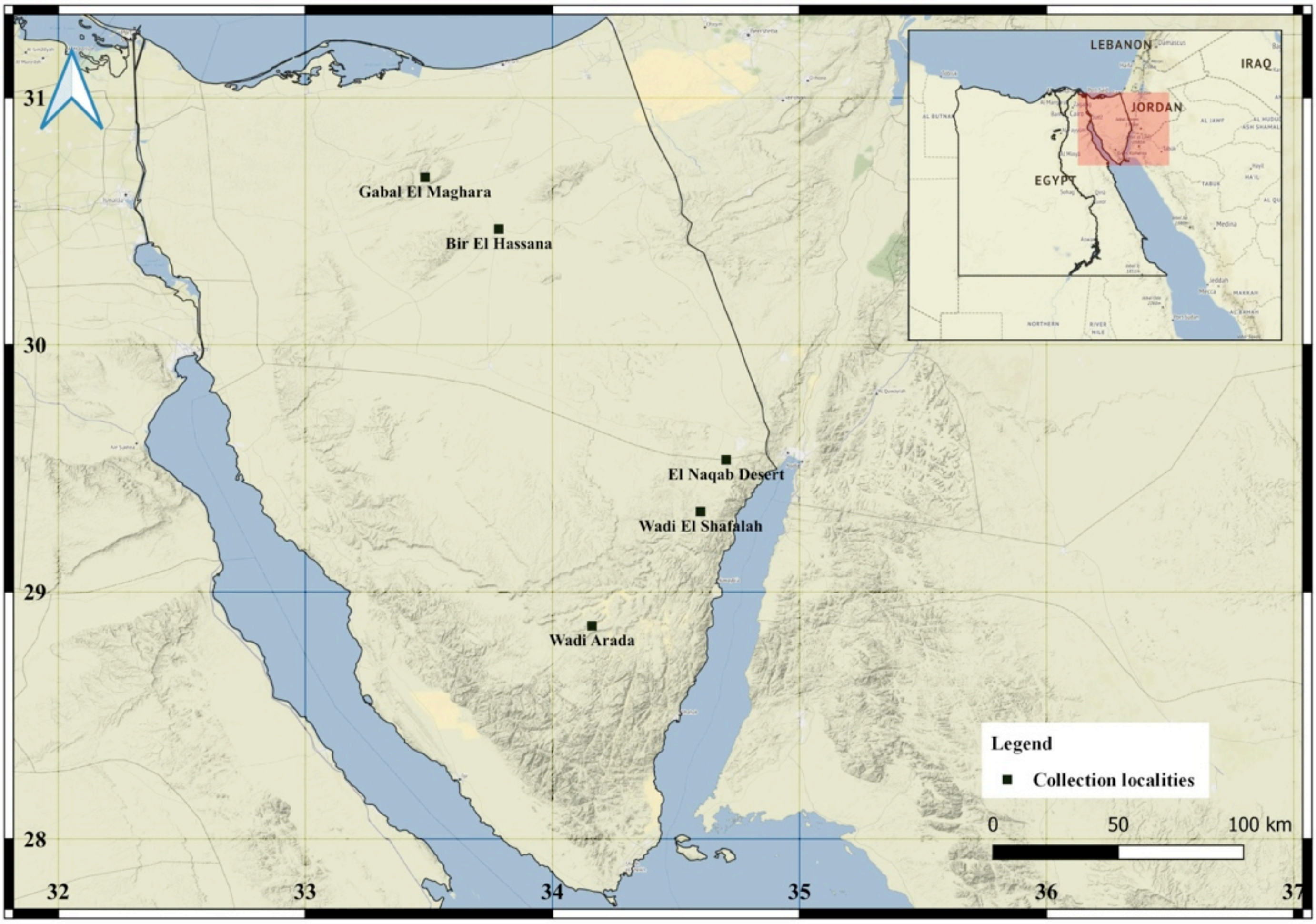

Fig. **17**. Map of Sinai showing the type localities of *Leiurus sinai* **sp**. **n**.

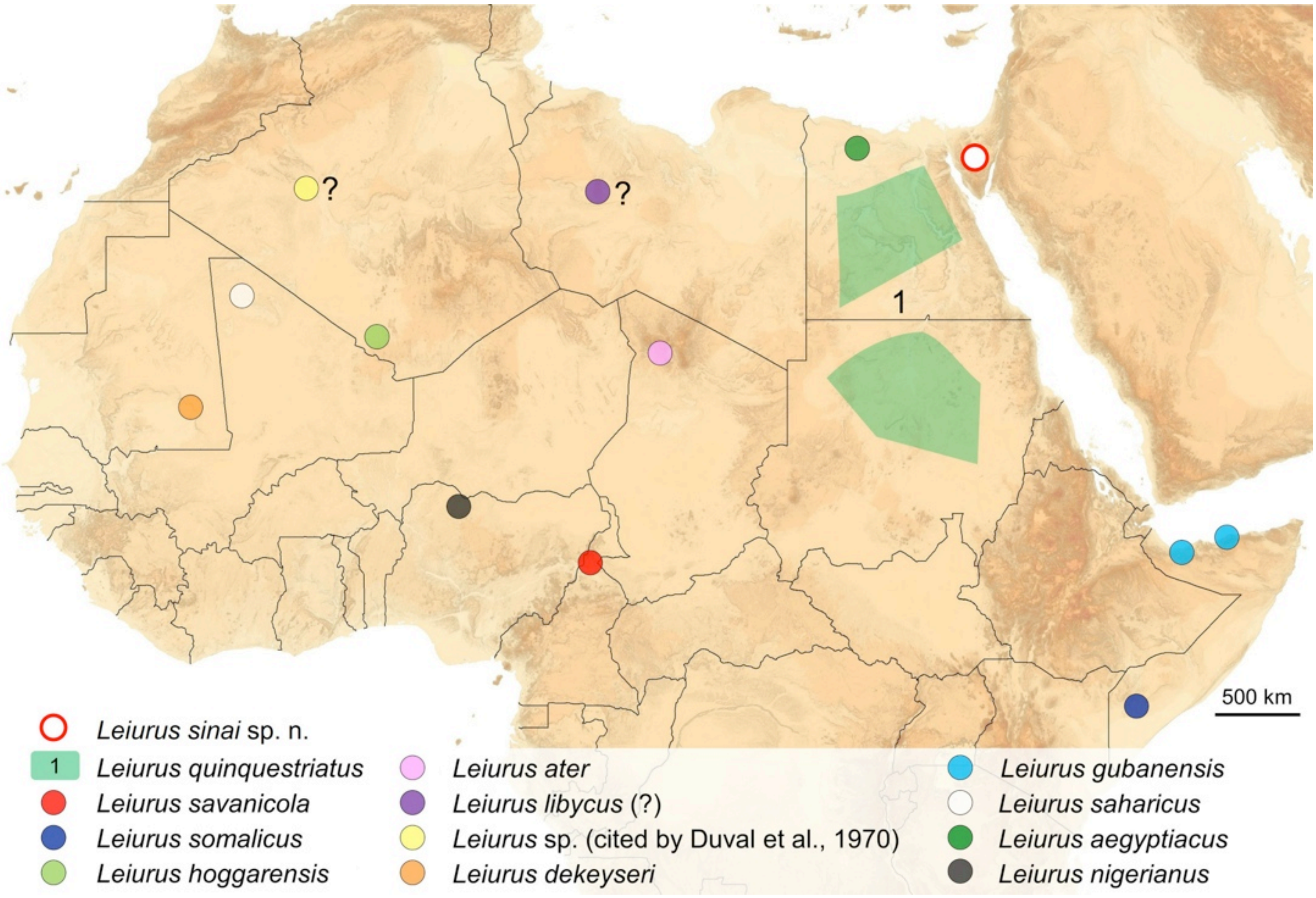

Fig. **18**. Map of Northern Africa showing the distribution of the known *Leiurus* species (modified from Lourenço, 2021).

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References

Akaike H., 1973. – Maximum likelihood identification of Gaussian autoregressive moving average models. *Biometrika*, 60(2), 255 - 265.

Abu Al-Izz M. S., 1971. – Landforms of Egypt. Cairo: The American University in Cairo Press. Dar Al Maaref.

Alqahtani A. R. & Badry A., 2020. – Interspecific phylogenetic relationship among different species of the genus *Buthacus* (Scorpiones: Buthidae) inferred from 16S rRNA in Egypt and Saudi Arabia. *Zoology in the Middle East*, 66(2), 178 - 185.

Gantenbein B., Fet V., Largiadèr C. & Scholl A., 1999. – First DNA phylogeny of *Euscorpius* Thorell, 1876 (Scorpiones: Euscorpiidae) and its bearing on taxonomy and biogeography of this genus. *Biogeographica*, Paris 75: 49 - 65.

Hall T.A., 1999. – BioEdit: a user friendly biological sequence alignment editor and analysis program for Windows 95/98/ NT. 41: 95: 98.

Hjelle J. T., 1990. – Anatomy and morphology. Pp. 9-63. In: G.A. Polis (ed.), *The Biology of Scorpions*. Stanford University Press, 587 pp.

Levy G. & Amitai P., 1980. – Fauna Palaestina. Arachnida I: Scorpiones. Israel Academy of Sciences and Humanities, Jerusalem.

Lourenço W. R. & El-Hennawy H. K., 2021. – New considerations on the *Leiurus* Ehrenberg (Scorpiones: Buthidae) distributed in Africa and description of a particular species from Egypt. *Serket*, 17 (4): 325 - 334.

Lourenço W. R., 2019. – Nouvelles considérations sur les *Leiurus* Ehrenberg, 1828 collectés dans la région du Tibesti, Tchad et description d'une nouvelle espèce (Scorpiones: Buthidae). *Revista Ibérica de Aracnología*, 34: 133 - 137.

Lourenço W. R., 2020a. – Why does the numbers of dangerous species of scorpions increase? The particular case of the genus *Leiurus* Ehrenberg (Buthidae) in Africa. *Journal of Venomous Animals and Toxins including Tropical Diseases*, 26: 1 - 9.

Lourenço W. R., 2020b. – A remarkable new species of *Leiurus* Ehrenberg, 1828 from the North Deserts of Mali (Scorpiones: Buthidae). *Revista Ibérica de Aracnología*, 37: 147 - 152.

Lourenço W. R., 2021. – A new species of *Leiurus* Ehrenberg (Scorpiones: Buthidae) from Nigeria, with extension of the distribution range of the genus to the Southwestern portion of the African continent. *Serket*, 18 (1): 1 - 10.

Lourenço W. R., 2022. – A new subgenus and species of *Leiurus* Ehrenberg, 1828 from Iraq (Scorpiones: Buthidae). *Serket*, 18 (4): 421 - 427.

Lourenço W. R., Kourim M. L. & Sadine S. E., 2018. – Scorpions from the region of Tamanrasset, Algeria (Scorpiones: Buthidae). II. A new African species of the genus *Leiurus* Ehrenberg, 1828. *Arachnida – Rivista Aracnologica Italiana*, 16: 3 - 14.

Lourenço W. R., Modry D. & Amr Z., 2002. – Description of a new species of *Leiurus* Ehrenberg 1828 (Scorpiones, Buthidae) from the South of Jordan. *Revue suisse de Zoologie*, 109 (3): 635 - 642.

Lourenço W. R., Qi J. X. & Cloudsley-Thompson J. L, 2006. – The African species of the genus *Leiurus* Ehrenberg, 1828 (Scorpiones: Buthidae) with the description of a new species. *Boletin de la Sociedad Entomólogica Aragonesa*, 39: 97 - 101.

Lowe G., Yagmur E. A. & Kovarik F., 2014. – A review of the genus *Leiurus* Ehrenberg, 1828 (Scorpiones: Buthidae) with description of four new species from the Arabian Peninsula. *Euscorpius*, 191: 1 - 129.

Nascimento C. W. A. D. & Xing B., 2006. – Phytoextraction: a review on enhanced metal availability and plant accumulation. *Scientia agricola*, 63: 299 - 311.

Rambaut A., Drummond A. J., Xie D., Baele G. & Suchard M. A., 2018. – Posterior summarization in Bayesian phylogenetics using Tracer 1.7. *Systematic Biology*, 67: 901 - 904.

Saleh M. A., Basuony M. I. & Tolba M, 2003. – Biodiversity and Zoogeography of the Qattara Depression, Western Desert, Egypt. *Egypt. J. Zool.*, 40: 357 - 387.

Sarhan M., Badry A.,Younes M. & Saleh M., 2020. – Genetic diversity within *Leiurus quinquestriatus* (Scorpiones: Buthidae) populations in Egypt as inferred from 16S mDNA sequence analysis. *Zoology in the Middle East*, 66 (3): 269 - 276.

Shata A., 1959. – Structural development of the Sinai Peninsula (Egypt). In Proc. 20th Int. Geol. Congr., Mexico, 1956 (pp. 225-249).

Smertenko A. P., Allwood E. G., Khan S., Jiang C. J., Maciver S. K., Weeds A. G. & Hussey P. J., 2001. – Interaction of pollen−specific ctin−depolymerizing factor with actin. T*he Plant Journal*, 25(2), 203 - 212.

Stahnke H. L., 1970. – Scorpion nomenclature and mensuration. *Entomological News*, 81: 297 - 316.

Swofford D. L., 2000. – PAUP*: phylogenetic analysis using parsimony and other methods (software). Sunderland, MA: Sinauer Associates.

Tamura K., Stecher G. & Kumar S., 2021. – MEGA11: molecular evolutionary genetics analysis version 11. *Molecular biology and evolution*, 38(7), 3022 - 3027.

Vachon M., 1952. – Etudes sur les Scorpions. Institut Pasteur d'Algérie, Alger: 482p.

Vachon M., 1963. – De l'utilité, en systématique, d'une nomenclature des dents des chélicères chez les Scorpions. *Bulletin du Muséum national d'Histoire naturelle*, Paris, 2e sér., 35 (2): 161 - 166.

Vachon M., 1974. – Etude des caractères utilisés pour classer les familles et les genres de Scorpions (Arachnides). 1. La trichobothriotaxie en arachnologie. Sigles trichobothriaux et types de trichobothriotaxie chez les Scorpions. *Bulletin du Muséum national d'Histoire naturelle*, Paris, 3è sér., n° 140, Zool. 104: 857 - 958.

Vachon M., 1975. – Sur l'utilisation de la trichobothriotaxie du bras des pédipalpes des Scorpions (Arachnides) dans le classement des genres de la famille des Buthidae Simon. *Comptes Rendus des Séances de l'Académie des Sciences*, 281 (D): 1597 - 1599.

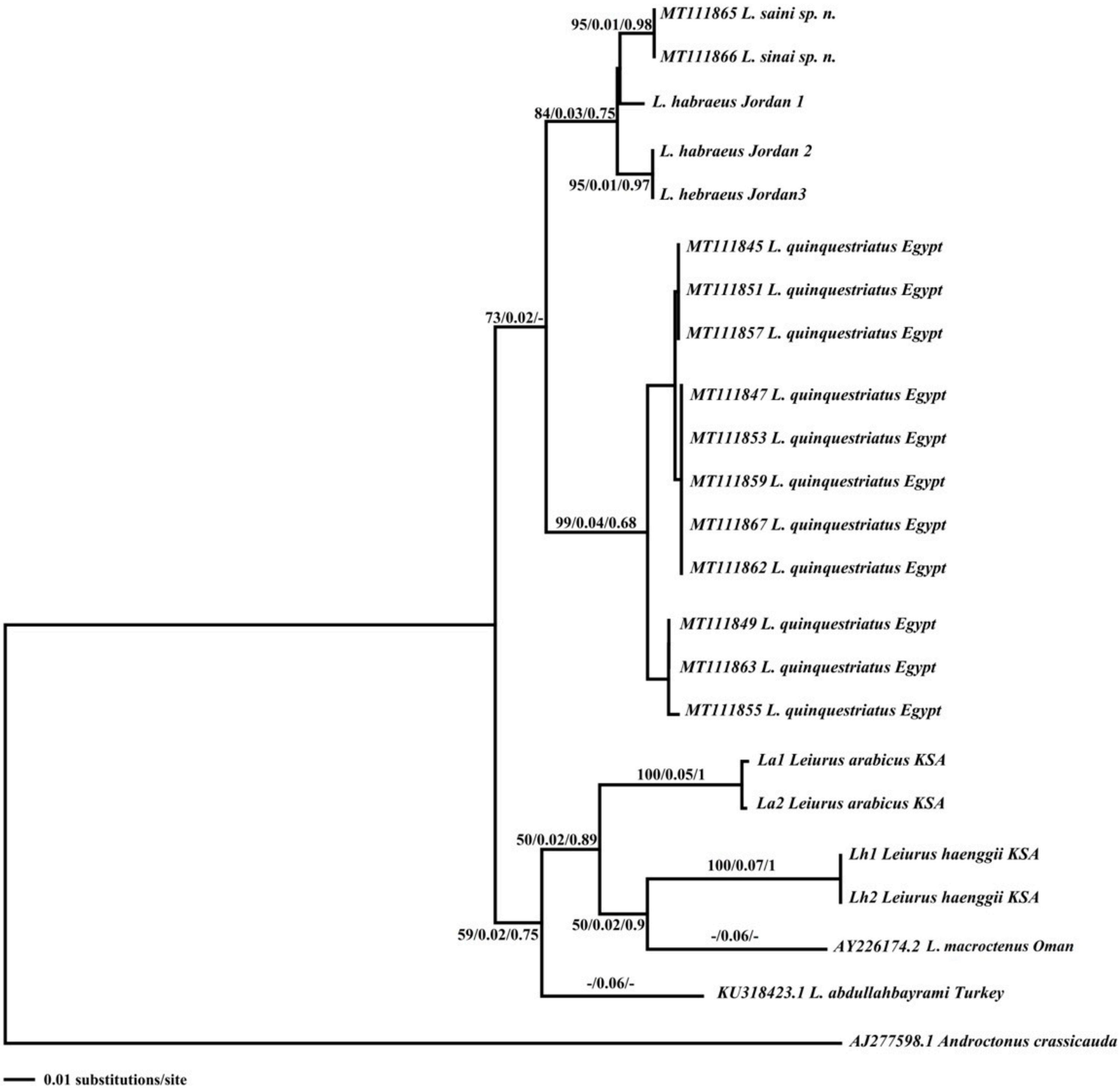
95/0.01/0.98
MT111865 L. saini sp. n.
MT111866 L. sinai sp. n.
L. habraeus Jordan 1
84/0.03/0.75
L. habraeus Jordan 2
95/0.01/0.97
L. hebraeus Jordan3
MT111845 L. quinquestriatus Egypt
MT111851 L. quinquestriatus Egypt
73/0.02/-
MT111857 L. quinquestriatus Egypt
MT111847 L. quinquestriatus Egypt
MT111853 L. quinquestriatus Egypt
MT111859 L. quinquestriatus Egypt
99/0.04/0.68
MT111867 L. quinquestriatus Egypt
MT111862 L. quinquestriatus Egypt
MT111849 L. quinquestriatus Egypt
MT111863 L. quinquestriatus Egypt
MT111855 L. quinquestriatus Egypt
100/0.05/1
La1 Leiurus arabicus KSA
La2 Leiurus arabicus KSA
50/0.02/0.89
100/0.07/1
Lh1 Leiurus haenggii KSA
Lh2 Leiurus haenggii KSA
50/0.02/0.9
-/0.06/-
AY226174.2 L. macroctenus Oman
59/0.02/0.75
-/0.06/-
KU318423.1 L. abdullahbayrami Turkey
AJ277598.1 Androctonus crassicauda
0.01 substitutions/site

Fig 19. Neighbor-joining (NJ) phylogenetic tree of *Leiurus* species based on 16S rRNA sequences. Numbers above and below branches indicate maximum parsimony bootstrap values/ NJ distance values /Bayesian posterior probabilities.

Authors contribution [1]

Project initiator. – AB
Scientific coordinator. – AB
Publisher correspondence. – EY
Writing the article. – AB, MS, MMS, MY, WL & EY
Description of the new species. – AB, MS, WL & EY
Article proofreading. – AB, WL & EY
Bibliographic work. – AB, MS, MMS, MY, WL & EY
Material morphological study. – WL & EY
Material molecular study. – AB, MS, MMS & MY
Author of the figures. – AB, WL & EY

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Résumé

Badry A., Saleh M., Sarhan M. M. H., Younes M., Lourenço W. R. & Ythier E., 2023. – Une nouvelle espèce du genre *Leiurus* Ehrenberg (Scorpiones : Buthidae) du Sinaï, Égypte. Commentaires sur les relations avec *L. quinquestriatus* et *L. hebraeus* à l'aide d'arguments morphologiques et moléculaires. *Faunitaxys*, 11(54): 1 – 10.

Le genre *Leiurus* fut à l'origine décrit en 1828 par Ehrenberg sous *Androctonus* (*Leiurus*) *quinquestriatus*. Durant presque deux siècles, il fut considéré comme monotypique, avec seulement deux sous-espèces valides : *Leiurus quinquestriatus quinquestriatus* (Ehrenberg, 1828) et *Leiurus quinquestriatus hebraeus* (Birula, 1908). Pendant les 20 dernières années, plusieurs nouvelles espèces de *Leiurus* furent décrites d'Afrique et du Moyen-Orient. Malgré cela, le status de quelques populations, comme celle de la Péninsule du Sinai en Égypte, restent encore à définir. Quelques études antérieures suggérèrent la population du Sinai comme distincte de *L. quinquestriatus* et *L. hebraeus* (Birula, 1908). La présente étude permet une comparaison plus approfondie de la population du Sinai avec *L. quinquestriatus* et *L. hebraeus* utilisant à la fois des critères morphologiques et moléculaires. Nos résultats suggèrent que la population du Sinai représente effectivement une espèce distincte, que nous décrivons dans le présent travail.

Mots-clés. – Scorpion, Buthidae, *Leiurus*, systematique, taxonomie, morphologie, nouvelle espèce, description, moléculaire, phylogénie, ARNr 16S, Sinai, Égypte.

	♀ holotype	**♂ paratype**
Total length (including telson)	76.7	69.4
Carapace		
- length	8.8	7.6
- anterior width	6.0	5.1
- posterior width	9.7	8.5
Mesosoma length	19.5	16.8
Metasomal segment I		
- length	6.3	5.8
- width	4.8	4.4
Metasomal segment II		
- length	7.4	6.9
- width	4.3	4.0
Metasomal segment III		
- length	7.5	7.2
- width	4.1	3.8
Metasomal segment IV		
- length	8.4	8.1
- width	3.8	3.4
Metasomal segment V		
- length	9.9	9.3
- width	3.6	3.2
- depth	3.4	2.8
Telson length	8.9	7.7
Vesicle		
- width	3.6	2.8
- depth	3.4	2.7
Pedipalp		
- Femur length	8.6	7.7
- Femur width	2.4	2.0
- Patella length	9.9	8.8
- Patella width	3.0	2.6
- Chela length	16.4	14.3
- Chela width	2.6	2.2
- Chela depth	2.6	2.2
Movable finger		
- length	11.3	10.3

Table I. Morphometric values (in mm) of the female holotype and one male paratype (from Bir El Hassana) of *Leiurus sinai* **sp. n.**

Species	Site
1. *MT111865_L._sinai_*sp._n.	29.050911 N, 34.405746 E
2. *MT111866_L._sinai_*sp._n.	29.289963 N, 34.469957 E
3. *L._hebraeus_*Jordan	30.408167 N, 35.460222 E
4. *L._hebraeus_2_*Jordan	30.408167 N, 35.460222 E
5. *La1_L._arabicus_*KSA	24.918132N, 46.487936 E
6. *La2_L._arabicus_*KSA	24.918132N, 46.487936 E
7. *Lh1_L._haenggii_*KSA	19.308734N, 43.677427 E
8. *Lh2_L._haenggii_*KSA	19.308734N, 43.677427 E
9. *MT111845_ L. quinquestriatus* Abu_Mingar_Oasis,_Egypt	26.506038 N, 27.644939 E
10. *MT111856_L. quinquestriatus* Faiyom,_Egypt	29.279919N, 30.576246 E
11. *MT111862_L. quinquestriatus* Eastern_Desert,_Egypt	23.689512 N, 35.336211 E
12. *MT111864_L. quinquestriatus* Siwa Oasis,_Egypt	29.151328 N, 25.793486 E
13. *AY226174.2_L._macroctenus_*Oman	-
14. *KU318423.1_L._abdullahbayrami_*Turkey	36.7964 N, 37.5875 E
15. *AJ277598.1_Androctonus_crassicauda* (out group)	-

Table 2. List of *Leiurus* samples used in this study and of 16SrRNA previously used in phylogenetic analysis.

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. MT111865_*L.*_sinai_sp_n.		0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03
2. MT111866_*L.*_sinai_sp._n.	0.00		0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03
3. L._hebraeus_Jordan	0.03	0.03		0.00	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03
4. L._hebraeus_2_Jordan	0.03	0.03	0.00		0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03
5. La1_*L.*_arabicus_KSA	0.16	0.16	0.16	0.16		0.00	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03
6. La2_*L.*_arabicus_KSA	0.16	0.16	0.16	0.16	0.00		0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03
7. Lh1_*L.*_haenggii_KSA	0.19	0.19	0.18	0.18	0.12	0.12		0.00	0.02	0.02	0.02	0.02	0.02	0.02	0.03
8. Lh2_*L.*_haenggii_KSA	0.19	0.19	0.18	0.18	0.12	0.12	0.00		0.02	0.02	0.02	0.02	0.02	0.02	0.03
9. MT111845_*L.* quinquestriatus Abu_Mingar_Oasis_Egypt	0.09	0.09	0.09	0.09	0.16	0.15	0.20	0.20		0.01	0.00	0.01	0.02	0.02	0.03
10. MT111856_*L.* quinquestriatus Faiyom_Egypt	0.08	0.08	0.08	0.08	0.17	0.17	0.19	0.19	0.02		0.01	0.00	0.02	0.02	0.03
11. MT111862_*L.* quinquestriatus Eastern_desert_*Egypt*	0.10	0.10	0.09	0.09	0.16	0.16	0.20	0.20	0.00	0.02		0.01	0.02	0.02	0.03
12. MT111864_*L.* quinquestriatus *Siwa*_Egypt	0.08	0.08	0.08	0.08	0.17	0.16	0.20	0.20	0.02	0.00	0.02		0.02	0.02	0.03
13. AY226174.2_*L.*_macroctenus_Oman	0.18	0.18	0.17	0.17	0.12	0.12	0.12	0.12	0.19	0.19	0.19	0.19		0.02	0.03
14. KU318423.1_*L.*_abdullahbayrami_Turkey	0.13	0.13	0.14	0.14	0.15	0.15	0.13	0.13	0.15	0.15	0.14	0.14	0.15		0.03
15. AJ277598.1_Androctonus_crassicauda (out groupp)	0.55	0.55	0.53	0.53	0.54	0.54	0.58	0.58	0.54	0.55	0.54	0.54	0.56	0.56	

Table 3. The uncorrected p distance of the sequence divergence of 16S mtDNA sequences between *Leiurus* samples was included in this study. Standard error are shown above the diagonal.

Derniers articles publiés

Théry T., 2023. – Description of *Derolathrus foveiceps* **n. sp**. from Florida (Coleoptera: Jacobsoniidae). *Faunitaxys*, 11(36): 1 – 4. https://doi.org/10.57800/faunitaxys-11(36)

Bate R. & Bate M. D., 2023. – New synonymies and distribution records of some longhorn beetles (Coleoptera, Cerambycidae) occurring in South Africa. *Faunitaxys*, 11(37): 1 – 9. https://doi.org/10.57800/faunitaxys-11(37)

Háva J. & Coache A., 2023. – *Anthrenus* (*Anthrenodes*) *sarahae* **sp**. **nov**., a new species from Benin (Coleoptera: Dermestidae). *Faunitaxys*, 11(38): 1 – 3. https://doi.org/10.57800/faunitaxys-11(38)

Keith D. & Coache A., 2023. – Sur *Phaeochrous thomensis* Arrow, 1909 (Coleoptera, Scarabaeoidea, Hybosoridae). *Faunitaxys*, 11(39): 1 – 5. https://doi.org/10.57800/faunitaxys-11(39)

Vlasak J. & Santos-Silva A., 2023. – Cerambycidae (Coleoptera) from Ecuador and Central America: new species and new country records. *Faunitaxys*, 11(40): 1 – 12. https://doi.org/10.57800/faunitaxys-11(40)

Gouverneur X. & Chemin G., 2023. – Description d'une nouvelle espèce du genre *Erythresthes* Thomson, 1864 du Laos (Coleoptera, Cerambycidae). *Faunitaxys*, 11(41): 1 – 3. https://doi.org/10.57800/faunitaxys-11(41)

Devesa S. & Vlasak J., 2023. – New species and new country records in Neotropical Cerambycidae (Coleoptera). *Faunitaxys*, 11(42): 1 – 10. https://doi.org/10.57800/faunitaxys-11(42)

Drumont A., Komiya Z., Do C., Toan Phan Q., Constant J. & Ripaille C., 2023. – Revision of the genus *Hystatoderes* Lameere, 1917 (Part I): species from Vietnam (Coleoptera, Cerambycidae, Prioninae, Anacolini). *Faunitaxys*, 11(43): 1 – 11. https://doi.org/10.57800/faunitaxys-11(43)

Le Tirant S. & Santos-Silva A., 2023. – Description of two new species of Cerambycidae (Coleoptera) and notes on *Macrodontia crenata* and *Deltaspis cyanipes*. *Faunitaxys*, 11(44): 1 – 13. https://doi.org/10.57800/faunitaxys-11(44)

Hennemann F. H., 2023. – *Theramenes letiranti* – a remarkable new species of Obriminae stick insects from Mindanao, Philippines (Insecta: Phasmatodea: Heteropterygidae). *Faunitaxys*, 11(45): 1 – 9. https://doi.org/10.57800/faunitaxys-11(45)

Háva J., 2023. – Study of the genus *Anthrenus* subgenus *Florilinus* from the Afrotropical Region (Coleoptera: Dermestidae: Megatominae). *Faunitaxys*, 11(46) : 1 – 2. https://doi.org/10.57800/faunitaxys-11(46)

Laguerre M., Espinoza B.A., Janzen D.H. & Hallwachs W., 2023. – Revision of the genus *Cloesia* Hampson, 1900: description of five new species and recombination of two species (Noctuoidea Erebidae Arctiinae Lithosiini). *Faunitaxys*, 11(47): 1 – 21. https://doi.org/10.57800/faunitaxys-11(47)

Háva J. & Hodeček J., 2023. – A new species of *Cryptorhopalum* (Coleoptera: Dermestidae: Megatominae) from the Dominican Republic. *Faunitaxys*, 11(48): 1 – 3. https://doi.org/10.57800/faunitaxys-11(48)

Keith D., 2023. – Rectificatif concernant *Miridiba brancuccii* Keith, 2023 (Coleoptera: Scarabaeidae, Melolonthinae, Rhizotrogini). *Faunitaxys*, 11(49) : 1. https://doi.org/10.57800/faunitaxys-11(49)

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Gouverneur X., 2023. – Description d'une nouvelle espèce du genre *Saperdoglenea* Breuning, 1964 de Malaisie (Coleoptera, Cerambycidae). *Faunitaxys*, 11(51): 1 – 4. https://doi.org/10.57800/faunitaxys-11(51)

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Háva J., 2023. – A new *Pseudotriphyllus* Reitter, 1880 species (Coleoptera: Mycetophagidae) from the Azores. *Faunitaxys*, 11(53) : 1 – 2. https://doi.org/10.57800/faunitaxys-11(53)

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SOMMAIRE

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Ahmed Badry, Mostafa Saleh, Moustafa M. H. Sarhan, Mahmoud Younes, Wilson R. Lourenço & Eric Ythier . . . . 1 – 10

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Illustration de la couverture :

Désert du Sinai.

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E. Ythier : Fig. 1-6.
W. Lourenço : Fig. 7-16 & 18.
A. Badry : Fig. 17-19 & couverture.

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